REMARKS/ARGUMENTS

This is in response to an Office action dated 04/13/2007. Applicant wishes to thank examiner Fulk for conducting a telephone interview about the referenced application with the undersigned attorney. The points of discussion are included in the remarks below.

Status

Claims 9, 10, 12, 13 and 15-17 are pending
Claims 9, 10, 12, 13 and 15-57 are rejected

Specification

"412" is changed to "420", per the Examiner's recommendation.

Rejection(s) under 35 USC 102

Claims 9-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Fujimaki '725. The Examiner states that,

> Fujimaki discloses a bipolar device comprising a collector region (fig. 2, NPN transistor, 105), a base film (fig. 4, 118b) disposed atop the collector region; an emitter structure (fig. 4, 122) formed atop the base layer; and a nitride stress film (fig. 4, 117) disposed adjacent the emitter structure and atop the base film, wherein the nitride film covers exposed surfaces of the emitter structure (fig. 4, lower surfaces of "T" in emitter 122 are covered by nitride layer 117); wherein the stress film is disposed in close proximity to an intrinsic portion of the device (p-n junctions form intrinsic regions); and wherein the emitter structure is "T-shaped" (122), having a lateral portion atop an upright portion, a bottom of the upright portion forms a contact to the base film, and the lateral portion overhangs the base film.

Rejection(s) under 35 USC 103

Claims 12-13 and 15-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujimaki '725 in view of Ko et al. ' 470. The Examiner states that,

> Fujimaki discloses all of the elements of the claims as set forth in paragraph 5 above, including forming a nitride stress film atop the base film, but the reference does not explicitly disclose the film to be a means to create compressive strain to increase the mobility of electrons in the device and a means to create tensile strain to increase the mobility of holes in the device, wherein the stress film has at least 0.5 GPa intrinsic stress. Ko et al. teaches a method of forming tensile and compressive stress using a silicon nitride layer (fig. 3g, 238/228) having at least 0.5 GPa stress (¶38) to improve carrier mobility in a transistor (¶43).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the stress of the nitride layer of Fujimaki as taught by Ko et al. One would have

been motivated to do this because Ko et al. taught that creating tensile and compressive stress in a transistor increased the carrier mobility in the device (¶43), thus improving the performance of the device.

Examiner's Response to (Earlier) Arguments

Applicant's arguments with respect to the rejection over Fujimaki have been fully considered but they are not persuasive. Applicant argues that nitride stress layer of Fujimaki does not anticipate the present invention because Fujimaki does not disclose the nitride layer covering all exposed surfaces of the emitter. This argument is not persuasive because claim 9 is written broadly enough to be anticipated by Fujimaki's nitride layer covering some exposed surfaces of the emitter, specifically the lower surface of the "T" shape of the emitter.

Applicant also argues that Fujimaki's nitride stress layer does not anticipate the present invention because Fujimaki performs additional process steps to reduce the stress in the layer. This argument is not persuasive because, although it is reduced, there is still inherent stress in the nitride layer and claim 9 is written broadly enough to be anticipated by any amount of stress present in the layer.

Applicant's arguments with respect to the rejection over Fujimaki in view of Ko have been fully considered but they are not persuasive. Applicant argues that Fujimaki uses epitaxially grown SiGe and Si to create stress and increase carrier mobility, and not the nitride layer. However, it was the Examiner's position that combination of Fujimaki in view of Ko renders the present invention obvious, specifically the nitride stress layer of Ko could be used in place of the nitride layer of Fujimaki to further increase the carrier mobility, and thus further improve the performance of the device. The use of epitaxially grown SiGe and Si to create stress does not preclude the use of a nitride stress layer to further enhance carrier mobility.

Remarks, Traversing the Rejection

During the telephone interview, the undersigned attorney initially discussed the construction of a Bipolar device as compared to a FET device. The discussion included the points set forth directly hereafter.

The present invention (see claim 9) is directed to a "Bipolar device, comprising:
a collector region,
a base film disposed atop the collector region;
an emitter structure formed atop the base layer ..."

A bipolar device is physically much different than a FET which has two diffusions (functioning as "source" and "drain") separated by a channel, atop which is a gate electrode controlling current flow through the channel.

Some general "analogies" can be made . Such as the source and drain of an FET are analogous to the collector and emitter of a bipolar device. And the gate of an FET controls current flowing between the source and drain, is analogous to the base of a bipolar device controlling current

flowing between the collector and emitter thereof.

The gate electrode of an FET is not physically between the source and drain, and current does not flow through it. (In an FET, current flows through the channel, the 'conductivity' of which is controlled by a gate voltage.) In a bipolar device, the base is physically disposed ('sandwiched') between the collector and emitter, and device current flows through it. These physical differences reflect the fact that bipolar devices and FETs operate in completely different manners.

For example, as is known, a bipolar device is a semiconductor device, the operation of which is based on the use of both majority and minority carriers (also referred to as "charge carriers"). The majority and minority carriers are either electrons or holes, depending on the polarity of the device. (page 1, paragraph 2) Furthermore, FETs operate fundamentally differently than BJTs. For one thing, there is charge flow in only one direction, which is parallel to the wafer surface. In addition, FETs have a single carrier (electrons for NFET and holes for PFET), and so the application of lattice strain is straightforward to create strain in principally one direction for the single carrier type. (paragraph 10)

Ko et al discloses a FET and is not applicable to bipolar devices. It therefore is inappropriate to combine Ko et al with Fujimaki, in the manner done by the Examiner.

Under 35 USC §103(a), in order to establish a prima facie case of obviousness of a claim, all of the claim limitations must be taught or suggested by the references cited, and all of the words in a claim must be considered in judging the patentability of that claim against the prior art. MPEP §§2143; 2143.03; In re Royka, 490 F.2d 981 (CCPA 1974). Moreover, there must be some suggestion or motivation to modify the reference, and a reasonable expectation of success. MPEP 332143.01-2143.03; In re Vaeck, 947 F.2d 488 (Fed. Cir. 1991). The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680 (Fed. Cir. 1990). Further, a proposed modification of prior art cannot render the prior art unsatisfactory for its intended purpose of change the principle of operation of the references. MPEP §2145.

Therefore, the rejection under 35 USC 103(a) of claims 12-13 and 15-17 cannot be sustained.

Returning to the 35 USC §102 rejection of claims 9-10, the following can be noted.

In claim 9 (as amended herewith),
the emitter structure is "T-shaped", having a lateral portion atop an upright portion;
a bottom of the upright portion ~~forms a contact to~~ contacts the base film;
the lateral portion overhangs the base film;

Reference is made to FIG. 3, wherein the T-shaped emitter structure 306 can be seen. The bottom of the T-shaped structure contacts the underlying base film 304. The base film 304 is approximately as wide as the lateral portion of the T-shaped emitter. The contact area between the bottom of the

emitter structure 306 and the base film 304 is quite small.

FIGs. 4A – 4F show the structure in somewhat more detail, but the same features can be observed.

In claim 9 (as amended herewith),

> a stress film disposed adjacent the emitter structure and atop the base film;
> ...
> the stress film comprises nitride; ~~and~~
> the stress film covers and is in direct contact with exposed surfaces of the emitter structure; and
> the stress film covers and is atop and in direct contact with exposed surfaces of the base film.

As discussed with the Examiner, the stress film is shown in the drawings as being in direct contact with the exposed surfaces of the emitter structure and the exposed surfaces of the base film. Therefore, these limitations are supported by the application as originally filed.

Fujimaki appears to have a T-shaped emitter 122 (FIG. 4, right, bottom), which is formed after a silicon nitride film 117 (FIG. 4, right, top) has been formed. This may account for the fact that the top of the emitter structure is not covered by nitride (the emitter is formed after the nitride).

Fujimaki's does not show "the stress film covers and is in direct contact with exposed surfaces of the emitter structure" (claim 9, as amended herewith).

Also, in Fujimaki, only a very small portion of the base film 118b (FIG. 4, right, third from the top) is contacted by the nitride film 117.

Fujimaki's does not show "the stress film covers and is atop and in direct contact with exposed surfaces of the base film." (claim 9, as amended herewith)

Also, Fujimaki's nitride film 117 is in two pieces, it is not continuous, as is the nitride film 308 (450) of the present invention.

As recognized by the Examiner, Fujimaki's nitride film is not a stress film. The Examiner cites Ko as evidencing that Fijimaki's nitride film could be a stress film. This is a "103" argument, and claim 9 has been rejected under "102". And, as described above, it is arguable whether Ko can be used as a 103 reference at all, since it is a FET, not a bipolar transistor.

The 102 rejection over Fujimaki cannot be sustained, even without the present amendment. Although Fujimaki has a nitride layer disposed similarly to the stress nitride layer of the present invention (on emitter and base), the Examiner recognizes that Fujimaki's nitride layer is not a stress layer. During the interview, the undersigned pointed out that Fujimaki uses epitaxially grown SiGe and Si to create stress and increase carrier mobility, and not the nitride layer. In the final office action the Examiner did note that the "combination of Fujimaki in view of Ko renders the present invention obvious, specifically the nitride stress layer of Ko could be used in place of the nitride [note: not "stress"] layer of Fujimaki to further increase the carrier mobility, and thus further improve the performance of the device. The use of epitaxially grown SiGe and

Si to create stress does not preclude the use of a nitride stress layer to further enhance carrier mobility."

This is a 103 argument (using two references to render the claimed invention obvious) which, even if it were true, cannot support a 102 rejection. And, it is disingenuous to suggest that since Fujimaki uses SiGe and Si to create stress, elsewhere in his device, that Ko (who has a completely different type of transistor operating differently than the bipolar transistors of the present invention and of Fuimaki) teaches Fujimaki getting rid of his SiGe stress layer and modifying his nitride layer to be a nitride stress layer.

Based on the above differences between Fujikami and claim 9 as amended, claim 9 should be deemed allowable.

Claim 12 is dependent upon claim 9 and states that the stress film is a compressive film. Since Fujikami does not use a stress film about the emitter and base film, claim 12 should also be allowable.

Claim 13 is dependent upon claim 9 and states that the stress film has at least 0.5GPa intrinsic stress. Since Fujikami does not use a stress film about the emitter and base film, claim 13 should also be allowable.

Claim 16 is dependent upon claim 9 and states that the stress film comprises: means for creating compressive strain in the device to increase mobility of electrons in the device; and means for creating tensile strain in the device to increase mobility of holes in the device. Again, since Fujikami does not use a stress film about the emitter and base film, claim 16 should also be allowable.

Claim 17 depends upon claim 16 and should therefore also be deemed allowable.

Conclusion

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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